Modular Biotreatment Systems Versus Oil-Water Separators

A Comparison of Pretreatment Technologies

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Oil-Water Separators (OWS) at NAS Patuxent River

- Thirty (30) oil-water separators
  - Aircraft Washracks
  - Aircraft Hangars
  - Military Vehicle Washracks / Transportation Building
  - Jet Engine Test Cells
  - Building Mechanical Process / Process Wastewater
- Discharge to sanitary collection system and state waters (Chesapeake Bay)
- 1986 Oil Water Separator Report
  - OWS on base are poorly maintained
  - Used on wastewaters where they have little effect
    - Soluble oils
    - Emulsified oils
  - Designed to remove free oils

Oil-Water Separators (OWS) at NAS Patuxent River

- **Operations and Maintenance Manual developed in 1997**
  - Estimated program costs (Preventive Maintenance & Cleaning)
    - Emergency response - $3,500
    - Annual cost (daily inspection) - $6,890
      - 190 hours per unit / year
      - Check sediment and oil depths
    - Annual cost (weekly inspection) - $1,600
      - 44.40 hours per unit / year
      - Check sediment and oil depths
    - Sampling for cleanout (TCLP) - $800
    - Annual cleanout (non-regulated waste) - $1,200
      - $0.75 / gallon
      - Based on average OWS capacity – 1,600 gallons
    - Annual cleanout (Hazardous waste) - $2,500
      - $1.50 / gallon
      - Based on average OWS capacity – 1,600 gallons
    - Steam cleaning or citric acid cleaning, and inspection - $100
    - Annual repairs - $500
    - ESTIMATED TOTAL ANNUAL COST: $4,200 to $12,000+

Are OWS truly effective?

Other Available Technologies

- Crossflow filtration
  - Ultrafiltration, Nanofiltration, Hyperfiltration (Reverse Osmosis)
- Chemical Absorption Separators
  - Chemical media to attract oil and repel water
- Mechanical Absorption Separators
  - Coalescer / pressure
- Vaporization OWS
  - External heat source boils off water and leaves oil
- Biological Remediation

Modular Biotreatment System

Why Choose This System?

- No mechanical filters or filter mediums
- No ozone, chlorides, or peroxides
- Aerobic system – virtually no odor
- Uses indigenous bacteria
  - The system maximizes the conditions to promote development of aerobic bacteria
- Organic pollutants are consumed instead of filtered out
- Low Maintenance (10 minutes per week)
  - Check lights and water level
- Water Quality Guarantee
  - Oxygen > 60%
  - Oil emulsion < 5 PPM
  - TDS < 1,500 mg/l
  - Conductivity < 2,000 micro siemens
  - Particle size < 5 microns
  - pH value 6.0 – 8.0
  - BOD < 150 mg/l
  - COD reduction 1:10

Sites

- Transportation Building
- Jet Engine Test Cell
- Steam Catapult

Transportation Building

- Base vehicle maintenance
- Vehicle washings
- Potential pollutants of concern
  - Petroleum products
    - Fuels, oils, greases
  - Surfactants (detergents)
  - Glycols (antifreeze)

Transportation Building (OWS)

Effluent Pit (1-29-2004)

Influent Pit (1-29-2004)

Jet Engine Test Cell

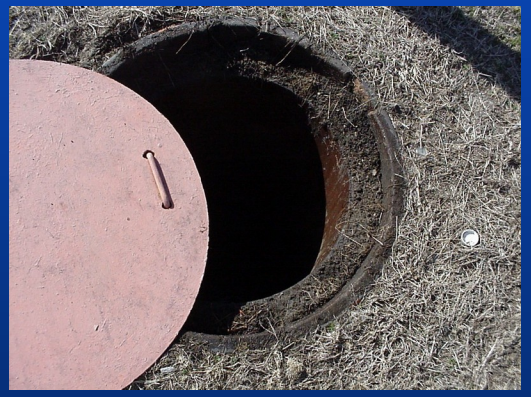
- Wastewater generated from a FOD washdown, and after-burn exhaust cooling
- Wastewater generated during operation – 5,000 gallons
- Two OWS in service
- Potential pollutants of concern
  - Petroleum products
    - Fuels, oils, greases
  - Glycol (from fuels)

Jet Engine Test Cell (OWS)

Jet Engine Test Cell (OWS)

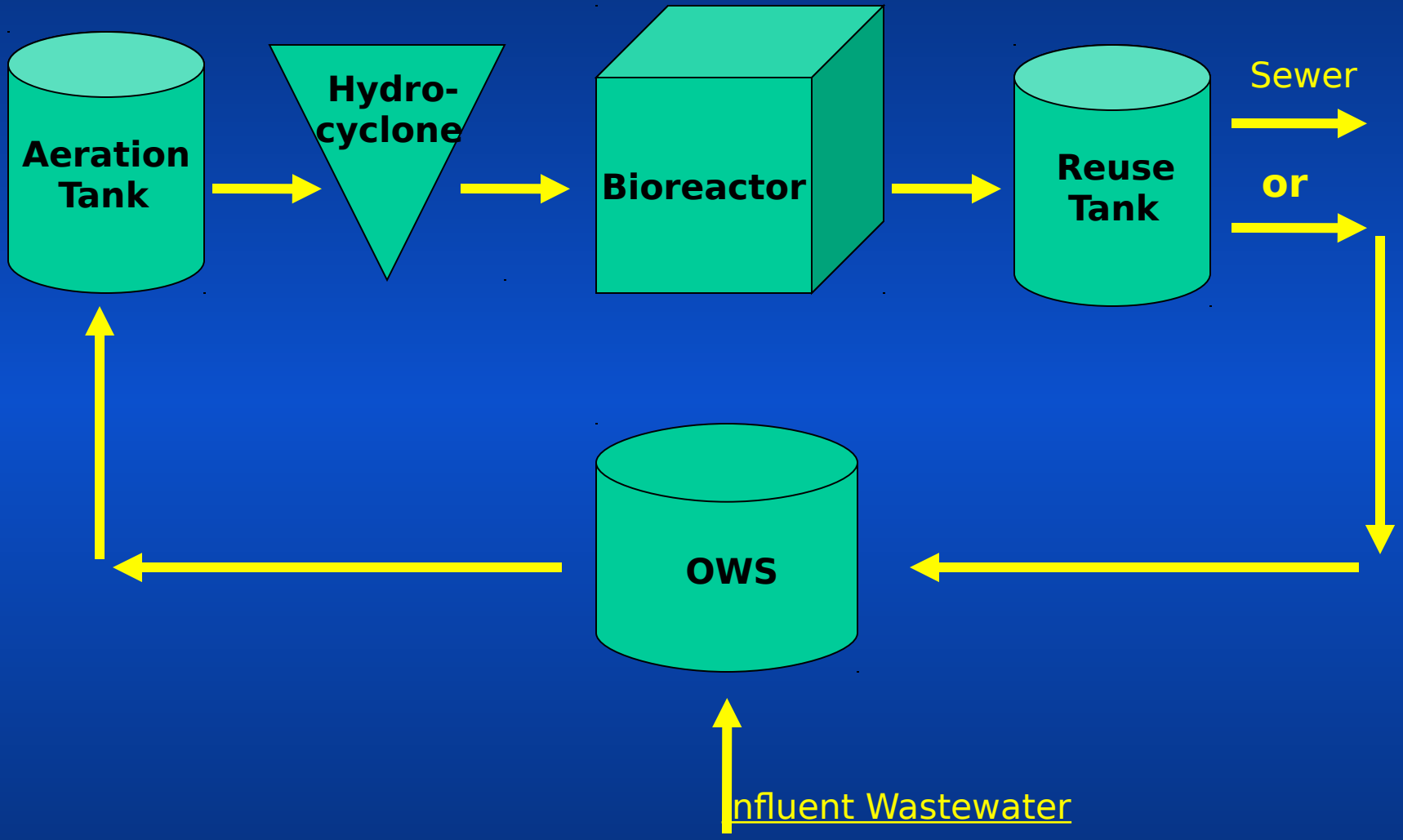
Steam Catapult (OWS)

- Wastewater generated – 3,750 gallons per launch
- Approximately 1 gallon of lube oil and grease is generated per launch
- Water Brake Tank (5,000 gallons) is drained after 50 launches
- Four OWS service the activity
- Potential pollutants of concern
  - Petroleum products
    - Fuels, oils, greases
  - Glycol (from fuels)



Steam Catapult (OWS)

Biotreatment System Flow Chart



Installation (General info)

- Site approval

- Above-ground or Below-ground system
  - Above-ground is less expensive and quicker/easier to install
  - Concrete foundation
  - Container (conex box) to protect system from weather / climate

Installation (Transportation)

- Cost for installation ≅ $63,000
  - Design
  - Bioreactor (500 gph)
  - Two 500-gallon tanks (aeration & reuse)
  - Pumps
  - Excavation
  - Concrete pad
  - Power hookup
  - Piping
  - Container (conex box)
  - Labor
  - Thermostat controlled infrared heaters
  - Ventilation
- Two week installation time

Installation (Jet Engine Test Cell)

- Cost for installation ≅ $115,000
  - Design
  - Two bioreactors (1,000 gph)
  - 1000-gallon aeration tank, 250-gallon reuse tank
  - Pumps
  - Excavation (tying in two OWS)
  - Skimmer for second OWS
  - Concrete pad
  - Power hookup
  - Piping
  - Container (conex box)
  - Labor
  - Thermostat controlled infrared heaters
  - Ventilation
- Two – three week installation time

Wastewater Sampling Comparison (Transportation)

Compound	Effluent 12-19-2003	Influent 01-08-2004	Effluent 02-19-2004	Effluent 03-03-2004	Effluent 03-12-2004
BOD	N/A	N/A	12 mg/l	10 mg/l	23 mg/l
TSS	55 mg/l	N/A	25 mg/l	21 mg/l	2.0 mg/l
MBAS	4.0 mg/l *	N/A	0.44 mg/l	0.32 mg/l	N/A
TPH	<2 mg/l	57 mg/l	2.0 mg/l	3.0 mg/l	3.0 mg/l
O & G	3 mg/l	N/A	5.0 mg/l	7.0 mg/l	5.0 mg/l
pH	7.12	8.62	8.0	8.0	8.2

Transportation Aeration Tank

03-02-2004

03-04-2004

03-09-2004

Transportation Reuse Tank

03-04-2004

03-09-2004

Wastewater Sampling Comparison (Jet Engine Test Cell)

Compound	Influent (OWS Pit) 03-05-2004	Effluent (Reuse tank) * 03-12-2004	EPA Method
BOD	1,500 mg/l	130 mg/l	405.1
TSS	9,300 mg/l	40 mg/l	160.2
TPH	51,000 mg/l	63 mg/l	418.1
O & G	70,000 mg/l	73 mg/l	413.1
pH	7.4	7.9	150.1

* System not in full operation

Jet Engine Test Cell OWS Pit

03-09-2004

03-11-2004

03-15-2004

Yearly Maintenance

- Oil-Water Separator Maintenance
  - **Estimated Yearly Maintenance Cost - $4,200 - $12,000**
    - Preventive Maintenance
    - Cleanouts

- Bioreactor maintenance
  - Weekly, quarterly, and annual inspections ($50 / hour) - $2,000
    - Weekly – 30 minutes
    - Quarterly – 1 hour
    - Annual – 2 hours
  - 90-day nutrient bag replacement ($276) – yearly cost $1,104
  - **Estimated Yearly Maintenance Cost - $3,200 - $4,000**

Comparison: Oil-Water Separator vs. Bioreactor

	OWS	Bioreactor
Cost	1,000 gallons - $8,000	1,000 gph - $35,000
Effectiveness	When properly maintained, removes free oils	Removes organic pollutants (petroleum hydrocarbons, detergents, etc.), and also small amounts of glycol
Longevity	Implemented on base possibly as early as 1940	At least 10 years
Yearly Maintenance	$4,200 - $12,000+	$3,200 - $4,000

Future Impacts

- Aircraft Wash Racks
- Closed-loop systems for water conservation
- Potential treatment/disposal of oil-contaminated water from spills
- Pretreatment alternative for other activities with petroleum or other organic pollutant issues

Acknowledgements

- NAS Patuxent River
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